ASSESSMENT OF TRAFFIC MANAGEMENT PRACTICES: THE CASE OF ROAD PROJECTS UNDER CONSTRUCTION IN ADDIS ABABA

MEng Project

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Contents

Acronyms and Abbreviations

AACRA	Addis Ababa City Road Authority
ADA	Americans with Disabilities
CCTV	Closed-Circuit Television
CHIN	Caltrans Highway Information Network
CHP	California Highway Patrol
CIS	Corrugated Iron Sheet
CMS	Changeable Message Signs
COS	Capital Outlay Support
COZEEP	Construction Zone Enhanced Enforcement Program
CPSD	Capital Project Skills Development
CTC	California Transportation Commission
DD	Deputy Directive
DTM	District Traffic Manager
EA	Expenditure Authorization
EMS	Extinguishable Message Sign
FHWA	Federal Highway Administration
FPMS	Freeway Performance Measurement System
FSP	Freeway Service Patrol
HAR	Highway Advisory Radio
HOV	High-Occupancy Vehicle
HQ	Headquarters
ITS	Intelligent Transportation System
LCRC	Lane Closure Review Committee
LCS	Lane Closure System
MZEEP	Maintenance Zone Enhanced Enforcement Program
PA&ED	Project Approval and Environmental Document
PCMS	Portable Changeable Message Sign
PID	Project Initiation Document
PIO	Public Information Officer

PS&E	Plans, Specifications and Estimates
RE	Resident Engineer
RTL	Ready to List
RTPA	Regional Transportation Planning Agencies
SSP	Standard Special Provisions
TMC	Transportation Management Center
TMP	Transportation Management Plan
TMT	Traffic Management Team
TTC	Temporary Traffic Control
WBS	Work Breakdown Structure

Terminologies

APPROVED TEMPORARY TRAFFIC MANAGEMENT PLAN(S): An arrangement of temporary signs and devices to warn traffic and guide it through or past a work area or temporary hazard that has been approved for use by the Engineer and the Employer

DELINEATION BARRIER: A barrier used to define hazards and guide traffic through the work site

DETOUR: Diversion of traffic on existing roadways because of obstruction of the existing roadway required to facilitate safe construction of the works.

MAJOR LANE CLOSURES: are closures that are expected to result in significant traffic impacts despite the implementation of TMPs. These closures can be implemented for capital projects, maintenance, or permit activities. A "significant project" as defined by the FHWA Final Rule, is one that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts greater than what is considered tolerable based on State policy or engineering judgment. This term is not used in these TMP Guidelines, because it refers primarily to capital projects and is not all-inclusive; maintenance and permit activities are not necessarily considered as projects, but the Districts prepare TMPs for those activities.

OBSTRUCTION: Any works or otherwise on or adjacent to an existing carriageway that requires modification to the existing traffic control arrangements.

PHYSICAL BARRIER: A temporary safety barrier required to provide a strong physical barrier between the travelled way and the work area.

REGULATORY TRAFFIC CONTROL DEVICE: Any sign, signal, marking or installation indicating an obligation to comply with a legally enforceable instruction

SIDE TRACK: A length of temporary pavement constructed for detour of traffic to allow safe construction of the works

SIGNIFICANT TRAFFIC IMPACT: was initially defined in DD-60 as an individual traffic delay of 30 minutes or more above a motorist's normal travel time. Significant traffic impacts can also occur when motorists experience shorter individual delays that may extend over several months or years. In some cases a full closure of a freeway segment may be justified for a short duration when compared to several months of weekend closures that may severely impact the business community and the public in general. The objective in developing TMP strategies is to balance short-term and long-term impacts to the traveling public with the safe, efficient delivery of highway construction projects and work zone activities.

TRANSPORTATION MANAGEMENT PLAN (TMP): is a program of activities for alleviating or minimizing work-related traffic delays by the effective application of traditional traffic handling practices and an innovative combination of various strategies. These strategies encompass public awareness campaigns, motorist information, demand management, incident management, system management, construction methods and staging, and alternate route planning. Depending on the complexity of the work or magnitude of anticipated traffic impacts, a TMP may provide lane requirement charts, Standard Special Provisions for maintaining traffic, and for a major project, a separate comprehensive report.

WORK ZONE/AREA: is the active area of a highway where construction, maintenance, or utility activities are being conducted. The work zone extends from the location of the first temporary traffic control device to the last temporary control device.

WORK SITE: An area which includes the work area(s) and any additional length of road required for advance signing, tapers, side tracks or other areas needed for associated purposes.

DECLARATION

I declare that this project entitled "Assessment of Traffic Management Practices: The case of Road Projects under Construction in Addis Ababa" is my original work. This project has not been presented for any other university and is not concurrently submitted in candidature of any other degree, and that all sources of material used for the thesis have been duly acknowledged.

Candidate:

Name: _____

Signature: _____

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ABSTRACT

Urban transport serves as veins to accelerate developments in industry, trade, education, health and other services. However, there is no compatible urban transport supply and effective management to meet the increasing trip frequency and mobility needs of the people and goods which resulted in the significance of the issue. Among the different challenges of the urban transport, Poor traffic management during construction & maintenance of roads is the one.

Traffic Management Plan (TMP) is prepared to identify and outline the manner in which construction traffic will be managed to ensure the safe and efficient performance of the road network, to minimize adverse effects on the existing community arising from construction traffic, and to provide the community with information about specific management methods to be employed during construction. The plan encompasses public awareness campaigns, motorist information, demand management, incident management, system management, construction methods and staging, and alternate route planning.

According to Addis Ababa City Road Authority's(AACRA) construction specification any new road construction or maintenance activates, in addition to the structural works, has to focus on the safe flow of traffic and the protection of persons and property through and/or around the work site for the duration of the project. However, the current road construction working trend is far behind what is expected in relative to its contractual provision and international experience. Moreover it is creating additionalcongestion onthecitytraffic system, unsafe vehicular and pedestrian movement and unfavorable living and working condition around the work site. This project work studied two selected road construction projects in city as a case study and an interview was made with the consultant, contractor and client of the projects. According to the interview and site observation, it looks that both parties only focuses on physical achievement, and poorly concerned for traffic management chaos resulted from road construction projects. And it is causing inconvenient way of movement for the users/public.

Key words: Traffic management plan, alternative route/detour, vehicular and pedestrian movement, signage

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CHAPTER ONE

1. Background

1.1 Introduction

According to United Nation estimate, as of July 2016 population of Ethiopia has reached 101,707,021 of which urban population was 20,202,815 accounting for 19.4% of the total population, having a growth rate of 3.8%. The population of Addis Ababa has reached 3,384,569 which accounted for 32.27% of the total urban population of the country (Central Statistics Agency, 2007). The expansion of the city, increasing population size coupled with the economic growth has required respective transport service supply for the increasing mobility needs of the People.

Urban transport serves as veins to accelerate developments in industry, trade, education, health and other services. However, there is no compatible urban transport supply and effective management to meet the increasing trip frequency and mobility needs of the people and goods which resulted in the seriousness of the issue.

Among the challenges of the urban transport include:

- Poor traffic management during construction & maintenance of roads
- Poor access to work place, education, health and other services due to lack of public transport service
- Declining attractiveness of road based public transport
- Continuous increases in transport fair especially for low income groups
- Lack of smooth traffic flow
- Lack of infrastructure for None Motorized Transport (NMT)(for walking and bicycle)
- High rate of traffic accidents
- Increasing air and noise pollution are the major ones.

Unless these challenges and other associated problems are addressed in time, they will have a negative impact on the socio-economic development of the city and on good governance which

directly affects the livelihood of the residents. In order to narrow the gap between urban transport demand and supply, to provide the transport service that can support the residents' socio-economic development effort, it is vital to take necessary measures which, in turn, will have an impact in solving complex problems observed in the sector. Different studies witnessed that Addis Ababa, the defacto capital of Africa, and capital city of Ethiopia suffers from inadequate transport service. Above all, day to day transport operation is arrested with complex issues and currently complaints of the service users are vivid. [2]

In other respect, there are opportunities which have a significant role in urban transport improvement. The commitment of the government and the interest of the residents, as well as the interest of the private sector to participate in improving the sector, are major issues to be indicated.

Addis Ababa, with an area of 540 km is divided into 10 sub-cities and 116 Woredas. The city is the country's political and economic center, the seat of Head Offices of African Union and United Nations Economic commission for Africa. It also accommodates many international Aid and Development organization and more than 100 embassies. The city's population is estimated to be 3,384,569 million. With the current population growth rate of 3.8% the city population is estimated to reach 8 million by 2020. [20] Addis Ababa is exhibiting high social, economic, structural and change is found to be a fast growing city. More than 70% of registered vehicles in the country are found in Addis Ababa. [17]

Moreover, there is no sufficient and comfortable pedestrian walkway. As far as the city development process is concerned, the infrastructure construction and the transport services are not in accordance with the transport plan. [19]

The main challenges are best explained as follows;

- Roads capacity and traffic flow does not work in a modern and coordinated manner,
- The increasing trend of traffic congestion,
- Lack of sufficient traffic signals, road signs and markings; coupled with non-functioning and ineffective feature of the existing ones,
- Lack of dedicated bus and bicycle lanes,

- Lack of parking facilities and over utilizing of on road parking,
- Lack of public and freight transport terminals with necessary facilities

Due to all these facts traffic congestions are now counted as a feature of the city. This challenge is mostly coupled by a poor traffic management of the city at all. Taking into account Addis Ababa‘s fast growth and to enable the transport sector to play its required role, the Government is investing a huge resource to construct roads so as to expand the road network. An effort has been made to improve the transport service provisions. After three years of preparation, and three years of construction time light rail transit (LRT) way is introduced to the city.

With the construction of Addis Ababa City Highway System the major emphasis of the Addis Ababa City Road Authority (AACRA) is largely focusing on exerting its effort to construct new roads and maintenance of existing facilities. As traffic demand alarmingly increases, work activities on the city Highway System will result in significant additional congestion, particularly in urban centers. Advance planning and coordination among all stockholders of Addis Ababa’s transportation are necessary to ensure that planned road construction will not result in extensive traffic delays to the public.

The concept of a Traffic Management Plan seems not new for AACRA with respect to the documentation or incorporation of this issue in to different bid documents. However, concerning the implementation of the concept is possibly new or even not yet started at all. Traffic management plan strategies are required for all planned construction, maintenance, and permit activities, which may range from a minor guardrail repair to a major bridge construction project.

This paper will try to assess the implementation traffic management on selected road construction projects in Addis Ababa city administration relative to the provisions of AACRA’s specification. According to AACRA’s construction specification, any new road construction or maintenance activities, in addition to the structural works, has to focus on the safe movement of traffic and the protection of persons and property through and/or around the work site for the duration of the project.

Construction always has some impact on the users of the facility. The various activities required during construction normally cause some disruption to existing pedestrian, bicycle, and motor vehicle patterns. In all but a few instances, the public must have some form of access through or around the work site. The planning, design, and preparation for modification of the normal traffic and pedestrian patterns during construction is commonly known as work zone traffic control. Traffic management plans (TMPs) are the result of this planning and design. [11]

Traffic Management Plan (TMP) is a program of activities for alleviating or minimizing work-related traffic delays by the effective application of traditional traffic handling practices and an innovative combination of various strategies. These strategies encompass public awareness campaigns, motorist information, demand management, incident management, system management, construction methods and staging, and alternate route planning. Depending on the complexity of the work or magnitude of anticipated traffic impacts, a TMP provides lane requirement charts, Standard Special Provisions for maintaining traffic, and for a major project, a separate comprehensive report. [10]

1.2 Statement of the Problem

A metropolitan and the capital of Africa and Ethiopia, Addis Ababa, which is serving as a sit of many international Aid and Development organization and more than 100 embassies is also known as the defacto capital of Africa which suffers from inadequate transport service.[5] The city's population is estimated to be 3,384,569 million and contains more than 70% of registered vehicles in the country, however, due to lack of effective mass transport system, the city mobility needs are mostly covered by road based; few number of buses, light rail transport and taxis.[17] Moreover, Roads capacity and traffic flow does not work in a modern and coordinated manner which leads to increasing trend of traffic congestion. This challenge is mostly coupled by a poor traffic management of the city at all.

Taking into account of Addis Ababa's fast growth and to enable the transport sector to play its required role, the government is investing a huge resource to construct roads so as to expand the road network. With the construction of Addis Ababa city highway System the barrier resulted from work activities on the city highway System is resulting a significant additional congestion. Advance planning and coordination among all stockholders of Addis's transportation is not observed and most concerned bodies are working in a fragmented manner which makes the problem more complex.

The developed nations mostly utilize the concept of traffic management plan to alleviate the additional traffic congestions generated from road construction & maintenance. Unlike this, here in Addis Ababa, almost all road construction & maintenance projects are under execution without such majors counterbalancing mechanisms. The concept of a Traffic Management Plan seems not new for AACRA in respect to the documentation. However, AACRA seems far behind from the expected effort concerning the implementation of the concept.

1.3 Objective of the Study

The main objectives of this study are;

- Assessing the implementation of traffic management of Addis Ababa city for selected road construction projects in relative to the provisions stated in AACRA's construction specification. and
- Reviewing international experiences in traffic management during urban road construction.

1.3.1 Specific Objectives

The specific objectives are;

- To assess the selected projects traffic management practices,
- Reviewing international experiences to see how road construction or maintenance activities done in regard to traffic management,
- Assessing communication practice of stakeholders and
- Assessing enforcement capacity of consultants and clients.

1.4 Scope of the Project

This project work is limited only to assess the traffic management of two projects which are under construction in the city, that are Teklehaimanot – Tewodros square-Grand palace link road project and 2nd police station – K/Mariam – Menilik hospital project that is planned to connect Piazza to Jan Meda. Moreover, due to lack of enough time and non-cooperation of some stockholders of the transportation sector the study lacks some basic data like recorded accidents due to the closure of access in relation to the commencement of the two projects in the city.

CHAPTER TWO

2. Literature review

2.1. Historical Development of Roads Construction in Addis Ababa

Early in the twentieth century, the first modern roads were constructed between Addis Ababa and Addis Alam, and between Harar and Dire Dawa. This was done with the assistance of Italian and French engineers respectively. Other roads followed in the next few years. [1]

Road-building was an especially significant development in the Ethiopian context, for it marked an important step towards economic and political unity, as well as the breaking down of parochial ways of thinking.

Contemporary attitudes to road-building may be seen from the fact that Menilek's chronicler likens the Addis Ababa-Addis Alma road to those of the Ferenge, or Europeans.

In support of this statement, he explains that Menilek had sent an engineer to Semien to improve the track, but that the local ruler, Dejazmach Gessesse, had "put so many obstacles in his way that he had to return without affecting anything." The Dejazmach, were told, had the full support of the local population, who declared, "If this road is improved, it will be all the easier for the Mosolones's and heathen to come up and attack us."[1]

During the last few years massive road construction and improvement works have been going on in the city. These contributed to the efficiency of transport mobility and changed the image of the city as well as facilitating other socio- economic developments. The road length envisaged by the Addis Ababa 2003 Master plan was 800 km. As of April 2010, constructed road and pedestrian walkway were 620km and 423km respectively. Currently the road coverage of the built area is 11.3% and it is envisioned to have the road network coverage about 20% by the year 2020. [16][18]

2.2. Transportation Features of Addis Ababa

2.2.1. Transport Service Provision

As the world population increases, life requires competition which needs increased mobility. Ability of moving from place to place with comfort, reasonable cost and desired time is one of the major factors affecting the competency of individuals. Human beings use different modes of transport for mobility. The growth of modes of transport varies based on the level of development of countries. As Ethiopia is a developing country, the transport service accessibility is low. Compared to the developed countries the mobility rate observed in the city of Addis Ababa is also low. In the cities of developed nations average mobility rate per person or trip/day is 2.5. According to the 2005 transport study, Addis Ababa's mobility rate or average trip/day/person is 1.08. In this respect the average length of mobility covered by vehicle is 3.3 km. and that of 1.5 by foot. In developed countries the length of mobility by walking is not more than 500mt. [19]

Transport studies indicated that in Addis Ababa there is a big gap between public transport demand and supply. The service standard is also low. Old neighborhoods far from the main roads and expansion areas of the city are not well served by public transport. The city's growth in economy, geographical area and population, brings urgent attention and needs additional mass transport service provision supported by capacity and technology.

Therefore, understanding this major challenge and giving special attention to the issue, a great effort is made by the government to realize technology transfer in mass transport by introducing Light Rail Transit (LRT), Bus rapid Transit (BRT) and Trolley Bus transport services.

2.2.2. Urban Land use and Transport Plan

Urban transport plan and implementation is based on land use plan and its implementation. As it is indicated in the Addis Ababa 2002-2010 master plan, the increasing pressure on public transport service, low fleet size of buses, unattractive location of freight and passenger transport terminals and weak traffic management system are the main challenges to mention.

According to the master plan, in order to alleviate the identified challenges, timely recommendations and outlined implementation strategies had been proposed as follows:

- To improve the efficiency of the city's public transport service and traffic management system,

- To provide the required bus stops,
- To relocate the freight depots from the center to the outskirt of the ring road so that the trucks will be serving there for loading and unloading,
- To build the capacity of concerned institutions in planning and management so as to upgrade them in performing urban transport planning and management.

However, though the adoption and implementation of the master plan has counted years, most of the recommendations and implementation strategies proposed in the plan are not implemented due to various problems. This is especially true that the urban transport plan and land development plan were not coordinated; lack of coordination among concerned stakeholders and lack of trained manpower are main problems that threaten the sector. On the other hand, in connection to the master plan many urban transport plan studies have been conducted, though they are not implemented

2.3. Traffic Management

One of the solutions to alleviate urban transport problems is to implement coordinated traffic management system. The city traffic management comprises four basic issues. [18] These are:

- Issues related to engineering
- Issues related to Education
- Issues related to Enforcement
- Issues related to Incident Management

2.3.1 Issues Related to Engineering

The city's road network, roundabouts, junctions, terminals and parking spaces are basic components of traffic management. However, some of these aforementioned road engineering elements have great influence on the traffic flow. Facilities like taxi stations, parking spaces, and traffic calming measures are not available in many corners of the city. Most of The available bus stops are not constructed to the standard and without due consideration of proper shades for passengers which, in turn, forced users to wait for the service in open air. Road ways do not give consideration for priorities for buses and mass transport vehicles and are not designed for longer trip lengths. Even the recently constructed ring road faces critical challenges to be

used for the intended objective due to implementation problems. Periodic maintenance on some of the roads is not sufficient. There are no sufficient expansion of interlink ages between functional roads. Above all, sufficient and comfortable pedestrian walkways are not constructed for the pedestrians who account the major trip percentage in the city. Though, there are demands for bicycle use, there is no sufficient and convenient bike-ways and bike-bays. This has rendered impact in making the traffic management activity inefficient.

2.3.2. Issues Related to Education

The knowledge and attitudes of the stakeholders towards traffic is decisive, in order to have efficient traffic management in the city. That is why; currently awareness about traffic is done in a better way as compared to the past years. Nonetheless, the training and awareness creation efforts concerning the issue are unsatisfactory and lack continuity. It is limited to few parts of the community which hinders to achieve the desired results. By the same token, the provisions of professional training of the implementing agencies are not related to the current objective conditions or with the necessary traffic laws and regulations.

2.3.3. Issues Related to Traffic law Enforcement

The enforcement effort is ineffective due to the fact that the responsibility of controlling, coordinating and law enforcement of the transport system and transport service is operated by different offices without coordination in a fragmented manner. Moreover, it becomes not easy to have an effective system because of lack of required professionals in the implementing agencies/offices, lack of opportunity to get the required sustainable training, professional composition, ethics training, surveillance and control. Consequently, most drivers and pedestrians do not respect laws, animal movement in the main road of the city is customary, no control on environment pollutant vehicles, traffic congestion is increasing, and as a result the rate of traffic accident is not decreased to the required level. Therefore, it is possible to say poor enforcement capacity is evident which made it difficult to provide efficient and quality services within the existing roads, traffic systems and transport services.

2.3.4. Issues Related to Incident Management

There are no satisfactory emergency incident management measures whenever traffic accident happened in the city. Incident management challenges observed due to lack of towing machines, lack of coordination among concerned agencies/offices like traffic police, Red Cross, Hospitals, towing machines operators and Fire Brigade and emergency accidents prevention and control agency. Whenever vehicles are exposed to accident on the main road, if they are not picked up quickly, they will be the cause to block the road affecting the traffic flow and will be additional challenge to the traffic management. And at the same time accident victims will be delayed or left without emergency medication services in time.

2.4. Review of Traffic/Transportation Management Plan (TMP)

2.4.1 International Experiences

Considering their experience, availability of compiled document and as an important source of knowledge, this paper nominates Californian TMP guideline for review which was prepared by California Department of Transportation on June 2009.

2.4.2 General

With the construction of California's State Highway System virtually complete, the major emphasis of the California Department of Transportation (Department) has largely shifted from new construction to reconstruction, operation, and maintenance of existing facilities. As traffic demand steadily increases, work activities on the State Highway System can result in significant additional congestion, particularly in urban centers. Advance planning and coordination among the Department's various divisions are necessary to ensure that planned highway work will not result in extensive traffic delays to the public.

The concept of implementing a Transportation Management Plan is not new. The Department's Districts have used transportation management strategies for decades to move motorists through work zones quickly and safely. The Department officially established the Transportation Management Plan program in 2000 through Deputy Directive 60 (DD-60) outlining strategies needed to minimize traffic congestion during road work activities. According to Californian TMP guideline TMP strategies are required for all planned construction, maintenance, and

permit activities, which may range from a minor guardrail repair to a major bridge construction project.

These guidelines identify the processes, roles, and responsibilities for preparing and implementing Transportation Management Plans, as well as useful strategies for reducing congestion and managing work zone traffic impacts.

2.4.3 TMP Strategies

A TMP encompasses activities that are implemented to minimize traffic delays that may result from lane restrictions or closures in a work zone. TMP strategies are designed to improve mobility, as well as safety for the traveling public and highway workers.

Californian TMP strategies are categorized as follows

A. Public Information

B. Motorist Information

C. Incident Management

D. Construction

E. Demand Management

F. Alternate Routes (or Detours)

According to the guide line, selection of TMP strategies in California are dependent on the type of work that is planned, the geographic and demographic area in which the work is located, and the anticipated traffic impacts.

Category A. Public Information

The public is highly interested in advance roadway information so that they can plan their travel accordingly. Due to the strong emergence of the Internet and hand-held electronic devices, public notification of planned and ongoing highway work is one of the most effective tools for reducing congestion in work zones. When the public is equipped with work zone information before they begin traveling, they have the opportunity to adjust their travel plans. Advance

roadway delay information can decrease the number of vehicles that may travel through the work area and can help to minimize traveler frustration. The information provided should include alternative transportation modes, such as transit services and bicycle routes that can be accessed during project construction and can lead to fewer vehicles on our highways and less congestion. In addition, public awareness campaigns inform the public of the overall purpose of the project and can help generate and maintain public support. Many of these strategies are typically used for major construction projects but can also be effectively applied to highway maintenance work or permit activities that may significantly affect traffic conditions.

In order to implement this strategy the following means of communications are utilized before and during construction or maintenance works.

- Brochures and Mailers
- Press Releases/Media Alerts
- Paid Advertisements
- Public Information Center
- Telephone Hotline
- Planned Lane Closure Web Site
- Project Web Site
- Public Meetings/Hearings
- Community Task Force
- Communication with Selected Stakeholders
- Information Kiosk
- Freight Travel Information.

Category B. Motorist Information

Motorist information is vital to travelers approaching a work zone and who still have time to make a decision that could divert them away from possible congestion. Given available information on travel delays or alternative routes prior to a decision point, the motorists can play an active role in completing their trips more smoothly and help reduce the overall congestion. When motorists are stuck in congestion, they can become frustrated and impatient. When they are given information on the length of delay and the reasons for the delay, their frustration levels are usually reduced.

The following are methods of communications for strategy B

- Traffic Radio Announcements
- Fixed Changeable Message Signs (CMS)
- Portable Changeable Message Signs (PCMS)
- Temporary Motorist Information Signs
- Dynamic Speed Message Sign
- Highway Advisory Radio (HAR)

Figure 1. Fixed changeable message sign

Category C. Incident Management

When traffic incidents occur on the State Highway System in or near a work zone, the most effective tool in reducing potential congestion is to remove the elements of the incident from the roadway as quickly as possible. An incident may range in severity from a flat tire to a multiple big rig collision with a hazardous waste spill that closes a section of highway for several hours. A standing protocol is in place for all traffic incidents as a part of the Traffic Operations Division's Incident Management Program. However, the TMP Manager should determine whether the standard protocol should be supplemented or whether additional strategies may be needed for certain types of projects or in certain areas.

- Transportation Management Center (TMC)
- Surveillance Equipment
- Traffic Management Teams (TMT)
- Helicopter for Aerial Surveillance
- Intelligent Transportation Systems (ITS)
- Tow/Freeway Service Patrol

Category D. Construction

Construction strategies can be effective in reducing congestion in a work zone. These strategies include, among others, innovative construction staging plans, lane requirement charts requiring crews to work at night instead of during daily peak commute periods, full closures of a roadway segment for a short period instead of nightly closures for several months or years, use of reversible lanes that can be modified to accommodate peak hour traffic in either direction, and use of contractor incentive and disincentive clauses within the contract. Similarly, reduced speed limits in work zones may not reduce congestion, but may make travel through the work zone safer for workers and the traveling public.

Among other categories of traffic management strategies "construction category" is the one that has to be well understood by contractor and consultant to identify their responsibility and role towards reducing massive obstructions and facilitating smooth traffic flow during construction.

Due to this benefit methods used for applying the strategy of construction will be reviewed in depth.

D1. Lane Requirement Chart: These charts identify the number of lanes that must be open for traffic each hour of the day to minimize delay when work activities are being conducted. These charts restrict work hours so that traffic is not affected during periods of peak travel demand and congestion (for example, peak hours, holidays, or special events). Work is typically performed during off-peak periods, such as at night, to minimize work zone impacts to motorists and adjacent businesses.

D2. Construction Staging: the Stage Construction Plan shows the sequence of construction activities. The Order of Work specification may identify portions of the project to be completed in a specific sequence to minimize impacts to the traveling public.

D3. Traffic Handling Plans: Traffic handling plans contain sufficient alignment detail, profiles, and typical cross-sections to guide traffic through the work zone in the sequence shown in the Stage Construction Plan.

D4. Full Facility Closures: This strategy involves complete closure of a roadway (either in one or both directions) or a freeway-to-freeway connector (ramp closures are typically not considered full closures). Full closures can minimize the duration of the project and improve worker safety. Full closures may be brief (intermittent, off-peak), short-term (night, weekend), or long-term (continuous for the duration of the project). Full closures typically require the involvement of the District public information officer (PIO) to ensure that a public information campaign with adequate advance notification is developed and implemented. Impacts to the alternate route should be monitored and managed to the extent possible. The Department encourages the use of full closures where feasible as long as adequate advance planning is conducted and appropriate TMP measures are implemented.

D5. Lane Modifications: It is essential to maintain the existing number of highway lanes to the extent possible. This can be done through lane modifications, which are typically in place for extended periods. Special consideration should be given to accommodate extra- high and extra-wide trucks where possible. Lane width reductions to less than 12 feet require approval from the District Traffic Liaison as well as a design exception. Lane modifications must also consider

bicycle and pedestrian users and emergency parking. Efforts should be made to limit the time a lane or shoulder is closed or reduced in width. Modifications may include the following:

- Reduced Lane Widths to Maintain Number of Lanes (Constriction). This involves reducing the width of one or more lanes in order to maintain the existing number of lanes on the facility while permitting work access to part of the facility.
- Lane Closures to Provide Worker Safety. This strategy closes one or more existing traffic lanes to accommodate work activities.
- Reduced Shoulder Width to Maintain Number of Lanes. This involves reducing the width of the shoulder for use as part of the traffic lane by shifting traffic onto the shoulder, allowing access for the work activities to take place. Adequacy of the shoulder pavement section to handle mainline traffic should be verified before using this strategy.
- Shoulder Closures to Provide Worker Safety. This strategy closes the shoulder for use by the public, making it available to accommodate the work activities. Where bicyclists or pedestrians are allowed, shoulder closures must provide for alternate accommodations.
- Lane Shift to Shoulder or Median to Maintain Number of Lanes. This strategy involves diverting traffic onto the shoulder/median, or a portion of the shoulder/median, for use as a traffic lane.

D6. Night Work: Work is performed at night (end of evening peak period to beginning of morning peak period) to minimize work zone impacts on motorists and adjacent businesses. Consideration should be given to potential impacts to residents due to noise, worker safety, and temperature requirements for paving operations.

D7. Extended Weekend Work: A construction work window may allow work to be performed during weekend periods from the end of the Friday afternoon peak period to the beginning of the Monday morning peak period (a 55-hour closure). This strategy may be difficult to implement in an area where there is a high volume of weekend tourist traffic. Consideration should be given to avoiding weekends in areas that may have a high volume of special events or tourist traffic.

D8. Pedestrian/Bicycle Access Improvements: This requirement involves providing alternate facilities for bicyclists and pedestrians in places where the work zone may impact their

accessibility and movement during highway work activities. Provisions of shuttle service may be necessary.

D9. Innovative Construction Techniques: (for example, precast members, rapid cure materials). These strategies involve the use of special materials, such as rapid curing concrete or precast items (for example, culverts, bridge deck slabs, and pavement slabs) to minimize the duration of construction or maintenance activities where traffic restrictions need to be minimized (for example, roadways with high volumes), and when work activities need to be completed during night or weekend periods to allow reopening travel lanes for normal weekday travel.

Category E. Demand Management

Demand management strategies can be used to encourage motorists to travel either in carpools or mass transit vehicles, or to vary work hours to reduce the typical peak hour traffic volumes. Rideshare incentives include free transit tickets or tickets at a reduced price. Park-and-ride lots can be built as a part of the project to encourage commuters to travel together, not only during but also after construction is completed.

Category F. Alternate Routes (Or Detours)

Figure 2. Temporary motorist information sign

Alternate route (or detour) strategies can be used to give travelers the opportunity to avoid the work zone completely by diverting to other highways or adjacent surface streets. This strategy includes examining the adequacy of detour or alternate routes and coordinating with the agencies responsible for those routes and the transit services on the routes. Use of a detour may require improving the effectiveness of the detour route by restricting parking or placing traffic control officers at critical intersections to help move traffic along during peak periods. Bicycle and

pedestrian accommodations (for example, access and length) must be considered when using alternate routes during construction. Methods possibly to be deployed for applying this strategy can include;

F1. Off-site Detours/Use of Alternate Routes This strategy involves rerouting some or all traffic from the roadway under construction or repair to other roadways. Detours need to be evaluated to accommodate extra-high and extra-wide trucks; any restrictions must be reported to the Transportation Permit Office. Before the work begins, it is advised to record the condition of the detour route to allow assessment of the roadway condition after the work is completed. During the work, traffic conditions on detours should be monitored to make sure that motorist delays remain within acceptable levels.

F2. Signal Timing/Coordination Improvements, This strategy involves retiming traffic signals to increase vehicle throughput of the roadway(s), improve traffic flow, and optimize intersection capacity in and around the work zone. Signal timing and coordination could include transit vehicle priority.

F4. Street/Intersection Improvements, Improvements on streets and intersections for the roadway or alternate routes may be necessary to provide increased capacity to handle the traffic through the work zone or within the adjacent corridor. This may include improvements to the mainline and intersections, including roadway or shoulder widening and construction of new through lanes and turn lanes. Pedestrian, bicycle, and transit needs should be carefully considered to maximize the positive impact of alternative modes.

F5. Turn Restrictions, This involves restricting turning movements for driveways and intersections to increase roadway capacity, reduce potential congestion and delays, and improve safety. Restrictions may be applied during peak periods or all day.

F6. Parking Restrictions, This strategy involves the restriction of parking in all or part of the work zone or alternate routes during work hours or peak traffic periods along alternate routes.

2.4.4 Preliminary Information Needed for Developing a TMP

The major input for selecting one or multiples of strategies for California State TMP is up to date information. According to the state's department of transportation, TMP is not an overnight effort for any of highway construction or maintenance works.

It is stated that, when developing a preliminary TMP, use the most current layout of the roadway (geometrics) information and plans available. The most current traffic volumes either at the specific location or as close as possible to the work zone site should be used to determine possible traffic impacts. Traffic information can be accessed through various sources: through the Department's Internet traffic data Web site, the Freeway Performance Measurement System via the loop detection system (devices set into the pavement that collect traffic data), special manual vehicle and occupancy counts, and through tachometer surveys which provide time and speed information. If current traffic counts are not readily available, a request for a new count should be submitted to the Department's Traffic Data and Photo log Office.

The data is typically used to determine the expected traffic delay at the work site and the work windows that will be made available. Sometimes projects that have been programmed and funded are "shelved" or delayed for a year or more, due to funding or environmental issues. When these projects are put back on the schedule, the traffic volumes and associated work windows need to be reviewed and updated to reflect the latest traffic conditions.

Information to consider when developing a TMP is listed in the following table.

• Latest traffic volumes (motorized, nonmotorized and truck traffic). • Lane closure policies and procedures. • Political or environmental issues. • Multijurisdictional communication and buy-in. • CHP and local law enforcement involvement. • Percentage of truck volume. • Business and affected activity centers impacts. • Clearance of alternate routes for Surface Transportation Assistance Act and oversized trucks.	• Concurrent corridor (including conflicting) construction projects. • Length of project (miles). • Urban versus rural conditions. • Time constraints (including duration). • Transit and Railroad services. • Viability of alternate routes. • Impacts on bicyclists, pedestrians, senior citizen facilities, or schools. • Current project layout and staging.

Table 1. Information to consider when developing a TMP

2.4.5 TMP Classifications

Californian department of transportation classifies TMP based on the anticipated impact of the highway work on the traveling public. The District TMP Manager determines the level of treatment required for the proposed work. The three classifications are described below.

2.4.5.1 "Blanket" TMPs

Certain low-impact Maintenance and Encroachment Permit activities do not require the development of detailed work specific TMPs. Those activities performed during off-peak hours on roadways with low volumes might be treated adequately with a "blanket" TMP. A blanket TMP may range in detail from approval for a lane closure by the district traffic manager (DTM) to a few selected strategies (such as PCMS activation) that would be taken to keep delay below the delay threshold. District Maintenance and Encroachment Permit offices should have a list of activities to which blanket TMPs apply. Depending on the type and duration of the proposed work, a blanket TMP may also include a one-page description of the activities to be performed and contact information for personnel involved in the activities.

2.4.5.2 "Minor" TMPs

Certain activities may result in traffic impacts on the State Highway System that are not "significant," as defined in this document, and may require a "Minor" TMP. A Minor TMP will likely include lane requirement charts specifying when the work can be conducted. Depending on the type and duration of the proposed work, a Minor TMP may also include a schedule and detailed description of the activities to be performed and the TMP strategies to be used, such as enhanced enforcement services, motorist information freeway service patrol during peak hours, and advance public information provided to the media.

2.4.5.3 "Major" TMPs

"Major" TMPs are prepared for capital, permit, and maintenance projects that could significantly impact traffic. Major TMPs may involve full and continuous closures. Generally, major TMPs are typically identified as follows:

- Multijurisdictional in scope, often encompassing the interests of California Highway Patrol (CHP), local law enforcement, city, county, and regional governments, bordering state transportation departments, employers, merchants, developers, transit operators, ridesharing agencies, neighborhood and special interest groups, emergency services, and transportation management associations.
- Multifaceted, comprised of traffic operations, facility enhancement, demand-management, and public relations strategies, as well as more traditional work zone actions, construction methods and contract incentives, customized to meet the unique needs of the impacted corridor.
- In place over an extended period of time, sometimes implemented a year or more before the start of actual construction, with specific elements often implemented incrementally to coincide with construction phasing.

Major TMPs may include the full spectrum of strategies, including lane requirement charts, special provisions for unique project characteristics, a large-scale public awareness campaign (with brochures, public meetings, project Web site, and telephone hotline), freeway service patrol, detours to alternate highways or surface streets, and special arrangements with local transit services to accommodate a significant increase in ridership. Due to the effort typically required on major TMPs, the Districts may choose to contract with a consultant.

2.5 Transportation Management Plan Process

TMP development begins at the initiation of the planning process. In the case of capital projects, it begins with the preparation of a TMP datasheet or checklist for each phase of the project as part of the Project Initiation Document (PID) process. The TMP is a "living" document and continues to be modified as work information warrants it. Frequently after construction or maintenance activities begin, if traffic conditions differ from what was anticipated, changes in TMP strategies may be necessary to keep motorist delays below acceptable levels. When modifications are made in the TMP, they should be approved by the TMP Manager.

2.5.1 TMP In The Project Initiation Document Phase

The extent of a TMP is determined by the District TMP Manager during the preliminary studies of a capital project. At the request of the project initiating unit (typically Design or Planning), the TMP Manager coordinates the preparation of TMP information that will be included in the PID phase. Projects are generally programmed, budgeted, and scheduled upon project approval at the end of the PID phase. It is extremely important to identify the proper scope and cost of the TMP activities in the PID, as significant post-PID approval changes will be difficult to obtain.

As soon as possible and prior to PID approval, the initiating unit sends conceptual geometrics to the District Office of Traffic Operations for evaluation. The TMP Manager and the DTM estimate the extent of the TMP required and determine whether potential traffic delays are anticipated that cannot be mitigated by traditional traffic handling practices or well-planned construction staging.

According to California department of transportation, at this stage two basic data are collected for a reasonable judgment on TMP

1. TMP Datasheet Preparation
2. TMP Cost Estimate

2.5.2 TMP During The Project Approval Phase

During this phase, studies of the identified alternatives are performed to determine the preferred TMP alternative. During the development of the project concept and staging, the Division of Design has the opportunity to incorporate traffic considerations that could potentially eliminate the need for extensive and expensive TMP strategies. During this phase the highest level deliverables completed are the Final Project Report and the Final Environmental Document.

In addition to this step TMP during the plans, specifications and estimates phase considers other aspects of TMP which are

- Preparation of TMPs During Design
- Acceptable Delay Thresholds

- Retrofitting TMPs for Programmed Projects
- Pedestrian and Bicycle Traffic
- Transit Services
- TMP Certification
- Construction Work Windows

Among these points, a striking point for the research team is their consideration for pedestrian and bicycle traffic. It is a learning point for Addis Ababa traffic management plan preparation and reviewed here under.

2.5.3. Pedestrian and Bicycle Traffic

Work zone activities can disrupt the public's mobility and access. Temporary lane restrictions, use of shoulders as travel lanes, detours, and other transportation management strategies should be designed to accommodate non-motorized travelers wherever they are legally permitted. Safe and convenient access should be maintained for pedestrians and bicyclists, who are susceptible to disruptions because of their slower speeds and sensitivity to noise, airborne dust, road debris, and fumes. Special care should be taken to consider areas where schools or senior citizen centers are located. A travel path that replicates, if possible, the most desirable characteristics of their usual travel route should be provided.

2.6. TMP Modifications During Construction

As a main objective of this research paper, learning from international experiences is one of point considered and due to the fact that projects considered in this paper are under construction stage reviewing Californian experience of TMP during construction stage might be helpful for all stockholders of this affair.

According to California Department of Transportation, contract-related TMP strategies are implemented by the contractor with Department oversight. Strategies related to public awareness may also be implemented by Department personnel. If project conditions change, traffic volumes increase or project staging changes, the DTM or the TMP Manager must be notified and consulted to determine if the TMP needs to be revised. The District PIO also needs to be involved early in

the planning phase to ensure adequate public awareness funding will be available throughout the project.

At times, certain activities may require more time than allowed by the lane requirement charts. In those instances, the Registered Engineer (RE) should contact the Engineer of Record (the group that developed the charts) or DTM and TMP Manager to request a longer work window. If that individual determines that minimal delays would be acceptable based on current traffic conditions, the charts may be adjusted to provide a longer work window. When work is allowed outside of the original work window, the District Transportation Management Team (TMT) should be contacted to monitor potential traffic backups.

2.6.1 Traffic Monitoring During Construction

The RE should ensure that inspectors monitor traffic conditions while work is being performed to avoid impacts in excess of what was identified in the TMP. When excessive queues occur, the TMC should be notified to initiate mitigation.

When congestion due to highway work zone activities is anticipated, traffic monitoring can be made a part of the construction contract or conducted by District TMT personnel. The traffic monitor typically uses a vehicle with a truck-mounted Changeable message signs (CMS) and stations the vehicle where approaching motorists can clearly read the CMS. This strategy provides periodic assessments of the effectiveness of project safety features and is often done at the beginning of a project to make sure that the TMP strategies are effective. Electronic monitoring and warning systems can also be used for this purpose.

2.6.2 TMP Coordination During Construction

TMP activities are to be monitored and evaluated by the TMP Manager or the TMP team and those elements found ineffective should be appropriately modified.

During construction, those TMP elements that are part of the main contract or Encroachment Permit are implemented under the general direction of District Construction or Encroachment Permits. Those separate contracts or agreements, for example, for rideshare and transit activities

and public awareness campaigns, will be under the direction of their respective contract managers.

Special effort should be given to assure that CMS, HAR, and other media tools provide accurate and timely information to motorists, bicyclists, and pedestrians regarding lane closure times and locations.

2.6.3 Late Lane Closure Pickup

The RE needs to ensure that lane closures will not be picked up beyond the lane closure window. Exceptions can occur when the activity needs to be completed for the safety of the public and workers. The RE should coordinate with the DTM if the contractor needs to work outside the lane requirement chart hours. The TMC should also be notified and the TMT may need to be called to monitor possible queuing.

In order to avoid significant traffic impacts, it is essential to monitor and respond immediately to delay, pick up closures on time, and have solid traffic handling and contractor Construction operations contingency plans. A Department staff member who can make informed decisions about implementing contingency plans and modifying, terminating, or extending approved lane closures should be available to respond to significant delays and other unexpected events whenever lane closures are in place. The designated employee(s) may be Traffic Operations, Construction, or TMC staff, depending on the District.

2.6.4 "After-Action" Reporting

At the end of a major project, a brief "After-Action" (post-TMP) report be completed by the TMP Manager this will help to identify the elements that went well and those that could have been done differently.

As a final review all works of TMP is evaluated for future adaptation and learning. The possible mechanisms that could be undertaken for evaluating TMP implantation are:

A. Field Counts and Surveys

• Field measurements of actual delay to the public (through electronic or manual data collection).

• Field observation of congestion queues by Department TMT personnel or by the contractor.

B. Public Surveys

• Questionnaires regarding how and when the public found out about the work.

• Logging of public complaints on Department Web pages or through telephone calls.

C. TMP Effectiveness Checklist Reporting on Factors, such as:

• The actual delay experienced

• Additional travel time

• Queue length

• Number of incidents in or near the work zone

• Incident response

• Impacts on adjacent construction activities

• The number of times that planned lane closures were picked up late and the reason

• Delay to transit services and ridership impacts

• Delay to bicyclists and pedestrians.

2.7 Work zone Safety

Effective work zone traffic control strategies encompass the safety of all users and workers, and are not limited to providing clear guidance and warning to motorists. Work zone areas present constantly changing roadway conditions that are unexpected by most users. Unless properly managed, these conditions pose a risk to facility users and construction crews.

2.7.1 Worker Safety

Working on highway construction projects is one of the more hazardous work environments in the state. The risk of being struck by a vehicle traveling through a work zone increases with higher traffic volumes and speeds. Long delays can sometimes cause motorists to become

impatient and act unpredictably. The designer should consider the risks faced by workers when developing a work zone management plan. In many cases, advisory signs warning motorists to reduce speeds are sufficient and the regulatory speeds are still valid. In areas more sensitive to speed reduction, reduced speed limits can be established. Advisory signs should be used in advance of the reduced speed limit zone to warn motorists of the upcoming change in speed limit. Speed limit and advisory signs should be reinforced with physical measures such as traffic barriers where appropriate.

Traffic barriers protect workers and reduce the need for many other traffic control devices and police presence. The cost of furnishing and removing temporary traffic barriers on long-duration projects can often be less than the cost of periodically relocating other traffic control devices and providing a higher level of police presence. Traffic barriers may also provide greater nighttime visibility of work areas or traffic shifts.

2.7.2 Road User Safety

Road users assume that they have full use of the facility, unless directed otherwise. The message conveyed to the user through signing, markings, and other traffic control devices must be consistent and credible. Considerations for the various roadway user groups are provided in the following sections.

2.7.2.1 Pedestrians

Pedestrian safety and accessibility are important issues in and around work zones. Pedestrians are susceptible to the impacts of changes in access, dirt, noise, and fumes in construction areas. Pedestrian routes through construction areas should be maintained. When a pedestrian route is affected by construction, temporary access and detours should be provided to ensure safe, unimpeded travel in and around work zones. Access to bus stops, crosswalks, sidewalks, and other origins and destinations should be maintained. Pedestrians should feel safe and secure when traveling near work zones.

Pedestrian Routes through Construction Zones

Proper planning for pedestrians through and along construction areas is as important as planning for vehicle traffic, especially in urban and suburban areas which have the highest volume of pedestrian traffic. Three key considerations for pedestrian safety in work zones are:

- Separate pedestrians from conflicts with construction vehicles, equipment, and operations.
- Separate pedestrians from conflicts with traffic moving through or around the worksite.
- Maintain pedestrian routes with a safe, accessible, and convenient path of travel that duplicates, as nearly as possible, the most desirable characteristics of sidewalks.

When construction requires closing sidewalks, crosswalks, paths and other walkways, a safe, accessible, and convenient alternative route must be maintained. The alternative route preferably should be provided adjacent or close to the existing route. Completely closing a sidewalk for construction and rerouting pedestrians to the other side of the street is another, less desirable option. In the event pedestrians are rerouted to the other side of the street, the street crossing should be located at an intersection, existing crosswalk, or other suitable and safe location.

If a temporary route is created in the roadway, shoulders, parking lanes, or travel lanes can be converted to temporary walkways using appropriate barricades, reflectorized drums, and signage. Walkways must be clearly identified and fully accessible for people with disabilities, protected from motor vehicle traffic, and free from hazards such as holes, debris, abrupt grade changes, mud, and standing water.

A width of at least 5 feet should be provided. Wider walkways may be necessary where there are high pedestrian volumes. Construction traffic control signs and other equipment should not be placed within the walkway and sidewalks open to pedestrians should not be used as storage areas for construction equipment, workers' vehicles, signs, barricades, or drums. Additionally, signs should not be placed where they block pedestrians using wheelchairs or protrude at head height (between 27" and 80").

At intersections, avoid closing crosswalks but mark temporary crosswalks if necessary. Access to pedestrian push buttons should be maintained, where applicable. Advance signage should be provided at intersections to alert pedestrians of mid-block worksites.

Protective Barriers

Barriers to prevent pedestrians from entering construction zones should be continuous and constructed of rigid materials in order to be discerned by pedestrians with vision impairments. The use of "caution" tape or other measures is not acceptable for defining a pedestrian route since these materials are easily broken and do not adequately direct pedestrians into the temporary pathway. Scaffolding and other construction fencing should not have objects that protrude into the clear head space for pedestrians. Temporary work on sidewalks also needs to be barricaded.

At fixed work sites of significant duration, especially in urban areas with high pedestrian volumes, fences may be needed to prevent pedestrian access into the construction site. Where used, fences should be 8 feet high. If chain link fencing is used around an existing sidewalk, signs indicating "Sidewalk Closed/Detour" should be placed at eye height to increase visibility of the fence. Covered walkways and other barriers must be designed to provide ample sight distance at intersections and crosswalks for pedestrians, cyclists, and motorists.

It may be necessary to use a longitudinal traffic barrier to separate the pedestrian from vehicular traffic. The barrier must be of sufficient strength to avoid intrusion by an impacting vehicle. See the AASHTO Roadside Design Guide. For work adjacent to high speed traffic, continuous temporary, pre-cast concrete barriers are recommended. Wooden railings, chain link fences, and other similar systems are not suitable for use in this situation.

2.7.2.2. Motorists

If motorists can easily understand the traffic control and have adequate time to make decisions, they will generally operate their vehicles in a safer manner. As speeds increase, the motorist requires more time to respond to conditions.

Insufficient, conflicting, or too much information conveyed by signage will confuse the motorist and contribute to erratic driving behavior. For example, credibility might be damaged if signing and other devices warn motorists of conditions that do not exist at the time, or provide incorrect directional guidance. Key elements of work zone management plans for motorists include:

- Speed reduction. Motorists tend to drive at a speed that seems appropriate for the setting. Imposing an artificially low speed limit is rarely effective, even for work zones. The designer must provide appropriate guidance and transitions from the normal speed condition outside the work zone to a lower-speed environment within the work zone.

- Enhanced enforcement. Police details are sometimes present in work zones and reinforce physical measures intended to reduce speeds and moderate driver behavior. In addition to construction zone details, aggressive enforcement of traffic regulations along approaches to and within construction zones can be an effective strategy for reducing motor vehicle speeds and moderating aggressive driving behavior.

- Temporary Traffic Control (TTC) Plans. A full complement of barriers, warning signs, pavement markings, and impact attenuators are available for use in different work zone management situations.

CHAPTER THREE

3. METHODOLOGY

3.1 Introduction

This chapter describes the methodology of the project. The main topics included in this chapter are study area, study design, Study subject, sample size, sampling method and method of data collection. The project strategy and design to be followed towards this end are discussed as follows.

3.2 Study Area

This study is conducted in two selected road construction project in Addis Ababa that is owned by Addis Ababa City Road Authority (AACRA). These are:

- Second police station – kidest Mariam – Minilik Hospital asphalt concrete project which links the road from Piazza to Jan-meda and
- T/haymanot – Tewodros Square Nigid Printing Press – Grand Palace asphalt Road project.

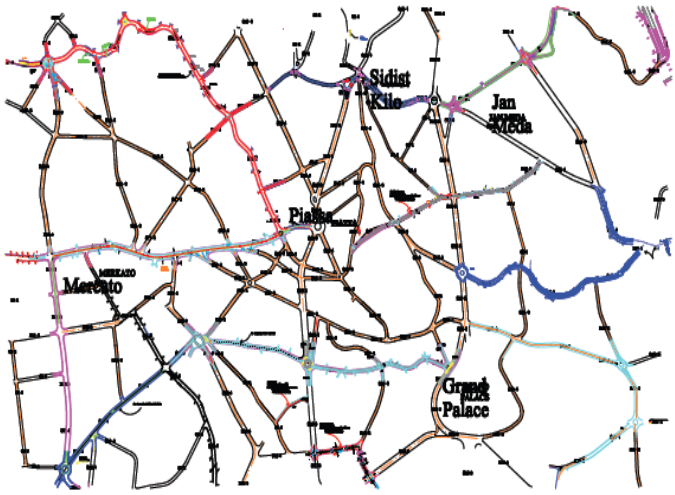

Figure 3.Location Map

3.2.1 Project Description

Case-1:- Teklehimanot-Tewodros Square-Grand Palace

T/Haimanot-Tewodros Square-Grand Palace link road construction project is an Asphalt concrete surface finish project owned by AACRA and having the overall length of 2kms. Generally in this project there are three major structure and drainage constructions, which are, two bridges located at 0+540 & 1+640 and one Box culvert at 1+120 km. The consulting engineer of this project is Best consulting engineers PLC and the contracting firm is SATCON Construction Pvt.Ltd.Co. It is scheduled to complete the project within 18 months and with the overall project cost of 189 million birr.

Case 2:- 2nd Police Station – Kidist Mariam – Menilik Hospital

It is a link road construction project contracted to construct Asphalt concrete surface finish owned by AACRA and having the overall length of 1.74kms. The consulting engineer of this project is Best consulting engineers PLC and the contracting firm is ENIY Construction Pvt.Ltd.Co. The contract was signed on May 21, 2015 & it is scheduled to complete the project within 15 months and with the overall project cost of 75 million birr. In this project there are structural works limited to pipe installation & manhole constructions.

3.3 Study Design

This project is designed to be a qualitative type by describing the existing situation of the stated projects as compared to the contractual provisions and international experiences in traffic management implementation around road construction projects. Case study research approach is deployed to investigate and analyze the practices of traffic management for both construction projects.

3.4 Study Subjects

This project has been emphasized on the following subjects which helped to conduct the case studies in depth and analyzing the situations around both construction projects. The Subject includes but not limited;

- Site access
- Signage
- Temporary traffic management
- Alternative vehicular routes (Detour)
- Pedestrians site access
- Special events & emergencies
- Existing property access
- Communication
- Dust, noise & vibration management

3.4 Sampling Method

Among those projects owned by AACRA which are under construction a simple random sampling method was employed to select the projects studied.

3.5 Methods of Data Collection

Different methods were utilized to collect and analyze data for the study. In this study document review for contractual provisions, digital photo shoots for observational study and interviewee with the three major parties representatives and road users were served as the source of data.

CHAPTER FOUR

4. Analysis and Discussion

4.1Introduction

The analysis and discussion part of the study is majorly framed to compare the actual situation of both projects in regard to traffic management implementation with the contractual provisions and international experiences as discussed in the literature review. In the process of analyzing the cases of both projects the researcher has found that both projects have similar status of practice since the contractual provisions, consulting firm and the Client are the same.

4.2 Traffic management Plan of the Projects

4.2.1 Contractual Provision in Regard to Traffic management

According to the construction specification Division 105 of AACRA "PROVISION FOR TRAFFIC", SATCON & ENIY are expected to cover all works necessary to provide for the safe movement of traffic and the protection of persons and property through and or around the work site for the duration of the project.

In the process of managing vehicular, motorist and pedestrian movements in connection to the construction of both projects the extent of work includes the design, construction, maintenance and removal of temporary roadways and sidetracks, the provision of traffic controllers lights, barriers, ramps, Signs, road markings fences, detours and any other items required for the safe and easy passage of all public traffic and shall apply where any public place or road is affected by the works. Unless otherwise specified all temporary traffic arrangements required by works under the Contract are included under this Specification.

Both Contractors must conform to the requirements of this Specification and the drawings when planning and carrying out traffic control and shall conduct all operations with the least possible obstruction and inconvenience to the public. The Contractors shall have wider construction no greater length or amount of work than can be prosecuted properly with due regards to the rights of the public. To the extent possible, the Contractors shall finish each section before beginning work on the next.

The general rules to be respected for the benefit of the traveling public and motorists and finally for the safe completion of the project with a minimal hazards, the specification has made its provision and some of them are summarized here under.

- Install and maintain temporary traffic control devices adjacent to and within the project as required by the traffic control plan
- Assign Traffic safety officer who is a knowledgeable member of his staff on site who shall be the responsible person for the arrangements and maintenance of all accommodation of traffic measures required for the duration of the contract. The responsible person shall liaise daily with the resident engineer in order to maintain proper traffic arrangements.
- The Contractor shall provide standard side trucks and responsible for the safe and easy passage of public traffic past and or over sections of roads that he/she has occupied. The Contractor shall take the necessary care at all times in all his operations and use of his equipment to protect the public and to facilitate the flow of traffic.
- The Contractor shall not interfere unnecessarily or improperly with the convenience of the public, or the access and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Employer or of others.

4.2.2 Provision as to Temporary Traffic management

ACCRA's specification section 105.3 provides the following as to Temporary traffic management plan and states that The Contractor shall obtain all necessary approvals from the relevant authorities (AACRA or consultant) for temporary traffic arrangements except where specified otherwise. At least five (5) working days prior to undertaking any work which would involve any obstruction whatsoever to traffic, the Contractor shall prepare and submit Temporary Traffic Management Plan(s) to the Engineer for endorsement. When endorsed by the Engineer, the Contractor shall proceed. Where the approved Temporary Traffic Management Plan(s) involve regulatory traffic control devices, the Contractor shall forward copies of the approved

plans to the local traffic police so that such traffic regulations may be enforced.

The Temporary Traffic Management Plan(s) is expected to have the following details

- Design drawings for any temporary roadways and sidetracks showing pavement, wearing surface and drainage details.
- Details of arrangements for construction under traffic.
- A signpost layout plan showing;
    - Location, size and legend of all temporary signs
    - Temporary regulatory signs and temporary speed zones and
    - All traffic control devices such as temporary traffic signals, road marking. Pavement, reflectors, guideposts, safety barrier systems, barrier boards etc.

4.2.3 Actual site Condition of the Project

It is difficult to make any difference for both projects while the researcher is exploring the existing conditions. Both projects are undertaking the construction works by full clothing of the routs. The actual site conditions of both projects are totally in contrast to what has been agreed and specified in the contract document. As it has been discussed about the specification of traffic management these projects were expected to install all necessary traffic control lights, barriers, ramps, Signs, warning taps, road markings, fences, detours and any other items required for the safe and easy passage of all public traffic. However, it is identified that both projects are doing nothing about the traffic management and safety of the occupants throughout the construction segment of the project.

Both routes are passing through the residential, commercial, religious and other communal areas of the traveling public, where there are infants, elders, disables and other age groups. Though it is the fact, pedestrians and motorists have no any reliable access in and around the project. Utility lines, like water, are not well maintained and exposed to contamination.

As it has been discussed in the literature review section of this research about the Californian TMP experience, the transportation management category for such types of road construction projects can be easily classified as major TMP. For such category of management all kinds of

strategies including, public information, motorist information, incident management, construction, alternate routes (or detours) shall be implemented to smoothen the traffic flow and satisfy access demands of pedestrian with safe conditions. In this regard, it is identified that both projects played zero effort for the implementation of such applicable and useful international experiences to safeguard public movements around the construction sites.

The following pictorial evidences can speak a lot about the existing situations of both projects.

Case-1:- Teklehaymanot-Tewodros-Grand palace Project

Figure 4. Infants playing around working zone with unsafe condition of public access.

Figure 5. Poorly installed water line which will expose the people for fatal contamination and serving as an obstacle for failure.

Figure 6. Though there is no any access for their customers, business centers are still opened without any attracting working condition

Figure 7. A disable person trying to cross where a full healthy person would suffer to do so.

Figure 8. Residential areas left without any protection exposing their privacy and safety, in addition an electric pole near to fail is left without any support

Figure 9. Motorists accessing working areas and near to collision with operating excavator even though there is no any proper entrance and exit accesses. On the top of this there is no any traffic safety officer or flag mans around the project

Figure 10. A picture showing demolishing of a bridge without any protection mechanism for pedestrians while they are accessing the working zone. The route has no any street light which worsens the risk of falling of pedestrians and Motorists during night time

Case 2:- 2nd Police Station – Kidiste Mariam – Menilik Hospital

Figure 11. Disconnected drainage line that collected sanitary west creating bad smell and unsafe condition for the shops and pedestrians.

Figure 12.Closed junctions by construction materials and improper slop/ramp to create difficulty in case of emergency

Figure 13. This is the alternative route at station 0+800 but the arrow indicates to wrong direction.

Figure 14. Contaminated drainage line that has very bad small. It is exposed without safety barrier where Children/pedestrian walking in unsafe condition.

Figure15.Kindergarten entrance left for climbing by the age group of 3-6 years old.

Figure 16. Careless Pipe storage endangering residences life for accident.

Figure 17. Unsupported residences and micro business centers left for sliding with unsafely restrained electric pole

Figure 18. Residential buildings left without any Protection and access

Figure 19.Construction work under progress without any sign for road closures while vehicular movement is active

Figure 20. Disconnected access without barricades exposing for accident during night time

There are additional pictures that can witness how this project is running with more than poor performances in regard to traffic management. It is known that Addis Ababa is the capital of Africa and Ethiopia which shall be example for the rest of other capital cities, however, the city is developing with poor safety measures in road construction projects which endangers the life of pedestrians and motorists. The situation assessed in this project exhibits that road construction projects are denying public & individual rights by exposing for life threatening work methodologies.

4.3 Attention given for Traffic Management Plan

Though there is a major gap for the implementation, relative to the past experiences of AACRA recent projects are showing a glimmer of hope towards the preparation of TMP. Both projects has prepared a layout of TMP lately after the commencement of site works, even though it was expected to submit before five days of any work is begin, according to AACRA's specification.

The attention given for traffic management plan in the existing provision seems less enough as compared to Californian experience. There in USA, traffic management plan begins during the design phase of any maintenance/construction projects and developed through proper studies and estimations to measure the extent of traffic congestions developed during the implementation phase of proposed projects. Therefore accidental planning encouraged by the client and late submission of TMP aggravates the problem observed during site visits.

In addition, the TMP layout was expected to contain location, size and legend of all temporary regulatory and speed limit signs, traffic control devices such as temporary traffic signals, road marking, reflectors, guideposts, safety barrier systems, barrier boards etc. However, especially the layout proposed for T/haimanot-Tewodros/-Grand palace project proposed TMP blindly shows only layout of access and direction of traffic flows.

Furthermore, ENIY construction is expected to display all the signs that are proposed in the approved traffic management plan but what is observed was far behind from AACRA's specification and Californian experience.

4.4 Strategies Proposed for Traffic Management and Safety

The strategy preferred to follow for managing the traffic around the project for both projects are adoption of alternative route or detours and the traffic diversion operation is planned to be made progressively by dividing in to two to three sections of work progress. Both projects have received their approved TMP layouts which contain primary, secondary and tertiary existing diversion detours.

According to AACRA's specification section 105.8 "*use of existing roads for temporary traffic diversions*", the Contractor can use existing roads for diversion after consultation with the owner or authority having control of such road after carrying out any repairs, alterations or additions to such roads as may be required to bring them in a condition suitable for the diversion of traffic.

However, the reality is different. There is no complain about the strategies preferred to be followed but the capacity and the condition of proposed alternative accesses are not studied in depth to propose such kind of traffic management, especially secondary and tertiary alternatives cannot even capable to serve at a time for pedestrians, cyclists and motorists approaching from opposite direction. On the top of this a steeped gradient of those proposed access are not maneuverable for loaded trucks which in turn endanger the safety of surrounding community. Moreover, there has no any maintenance or alteration made on these access to bring them in a condition suitable for diversion of traffic.

Figure 21. One of the secondary proposed detours, which is not enough for pedestrians, two cars from opposite directions and surrounding residences

Figure 22. A secondary detour having very steeped gradient which is difficult to climb for a loaded truck

Actually AACRA's provisions made for traffic management do not encourage or enforce the contractor to make substantial studies like Californian guide line in regard to traffic volume, %age of truck volume, viability of alternate route, impact on pedestrians and senior citizens etc. for the nomination of alternative routes for traffic diversions. In addition, the provisions are leading to conclude that preparation of TMP for any construction project is only contractor's obligation. The possibility of producing sound TMP from a single contracting firm is very difficult and will be a source of bias and one directional with lots of weak points.

4.5 Efforts Made by AACRA for Enforcement of Contractual Provisions

According to, the interview made with the counterpart engineers these projects the proposed traffic management was almost their first experience during their stay in the institution. Especially one of the counter engineer had no any idea whether ACCRA has such traffic management provisions or not. This shows not only the knowledge gap of the employee but the institution (employer) by itself seems have no any system or tradition to introduce its manual for newly hired engineers. Fresh graduates from different institution are hired and left to work intuitionally and expected to produce quality results from administrating such defective projects.

This seems that the main root cause of traffic congestion related chaos, life threatening hazards, unsafe construction practices and disrespect ion of contractors for the pedestrians and residence around construction projects are results of non-competency of AACRA to train and coach its employees for the implementation of contractual provisions. Due to this fact, it is impossible for someone to control something that he/she doesn't know at all.

On the other hand as a consulting firm, Best consulting engineers shall do something better to change the situation in this regard. It is there to advice both the client and the contractor for any work related to road construction. Receiving and approving paper layout plans does not mean traffic management in road construction industry, it would rather study in depth to identify any challenges raised in relation to road disruption and proposing applicable solutions before things getting worse.

Structural Organization for TMP

It is AACRA's dream that all road construction projects shall deploy technicians who are expertise in traffic management. However, such officials are invisible for both projects. At least there shall be flag man to harmonize the traffic flow around the working zone but there were no such personnel for both projects

4.6 Coordination of Stockholders

Special effort should be given to assure that media tools provide accurate and timely information to motorists, bicyclists, and pedestrians regarding lane closure times and locations. Moreover, in order to enforce the TMP of a project, traffic police officers has to be informed and be ready to deploy police force for the enforcement of temporary regulatory, speed limit, closure and other traffic related markings. In this regard AACRA is currently using FM 96.3 and other radio stations to communicate the closure of access roads in the beginning of any road construction project in the city but it is not continues and updated progressively.

As it has been discussed in the literature review, one of Addis Ababa's traffic management problems was ineffective enforcement effort, due to the fact that the responsibility of controlling, coordinating and law enforcement of the transport system and transport service is operated by

different offices without coordination in a fragmented manner. Moreover, it becomes not easy to have an effective system because of lack of required professionals in the implementing agencies/offices, lack of opportunity to get the required sustainable training, professional composition, ethics training, surveillance and control.

From the result of interview made for AACRA's counterpart engineers and a traffic management officer of Addis Ababa City Transport Bureau, the approved TMPs of both projects are not communicated with all stockholders. The plans are just known by AACRA and filed as any correspondence with the contractor. According to AACRA's specification the contractor has the obligation for the approved TMP to make known by the concerned traffic office but it is not done. Therefore, the coordination of all concerned body for traffic management of the city is poor unlike to Californian experience.

CHAPTER FIVE
CONCLUSION

- It is possible to conclude that traffic management of Addis Ababa is far behind what is expected.
- All concerned stakeholders are working in a fragmented manner and lacks coordination.
- Provisions made by AACRA are not implemented satisfactorily according to the specification.
- AACRA looks only focusing on physical achievements and poorly concerned for traffic management chose resulted from road construction projects.
- AACRA lacks the charisma of training & coaching of its employees for the implementation of traffic management provisions.
- The city transport bureau has no effective traffic management officers.
- In general weather the city transportation bureau or AACRA has no any Traffic/Transportation management plan guidelines for reference and preparation of sound TMPs.
- Contractors & Consultants are not working responsibly for traffic management and safety of the people.
- Traffic management plans proposed for implementation are not based on intensive studies and not communicated for all concerned bodies.
- The tradition of abiding for traffic laws by pedestrians and motorists is very weak, due to this fact most pedestrians and motorists are observed breaking temporary traffic laws to access restricted working areas.
- Due to poor coordination of law making and enforcing body of the city administration traffic congestion and poor safety protocols are still major problems around and at road construction projects.
- Even though Traffic management plans are prepared there is no continuous follow up from the enforcing bodies.
- Proposed detour accesses are under service without any maintenance activity and some of them have no capacity to accommodate the additional traffic load.
- Pedestrians are susceptible to the impacts of changes in access, dirt, noise, and fumes in construction areas.

- In both Projects Pedestrians are not properly considered to access their home or working place. Especially disables have been missed totally.

CHAPTER SIX

RECOMMENDATION

- All concerned stockholders have to work with coordination to alleviate the chaos of traffic congestions which aggravates traffic accidents and hazards.
- As a leading body, the city transport bureau has to prepare an enforcing traffic management and safety guidelines.
- Pedestrians & motorists have to abide themselves for permanent and temporary traffic laws of the city.
- AACRA must check itself and make changes to be effective for the implementation of provision for traffic management through capacity building of concerned engineers.
- Preparation of traffic management plan for any road construction & maintenance project has to be the assignment of all concerned stakeholders to draft a scientifically studied and viable draft document.
- Traffic management plans has to be prepared in parallel to the main design work.
- Public meetings have to be prepared for discussion with different stakeholders so as to create public awareness rather than rushing and starting a project without informing the end user of the facility.
- By taking air time in radio, TV or newspaper give public information about road closure, safety of road user both driver and Pedestrians.
- For permanent solution of traffic related problems a separate body specialized for traffic management has to be formed to give solutions for all traffic related problems through coordination with other concerned stockholders.

Finally, I recommend further research study in this area to be conducted by interested researchers.

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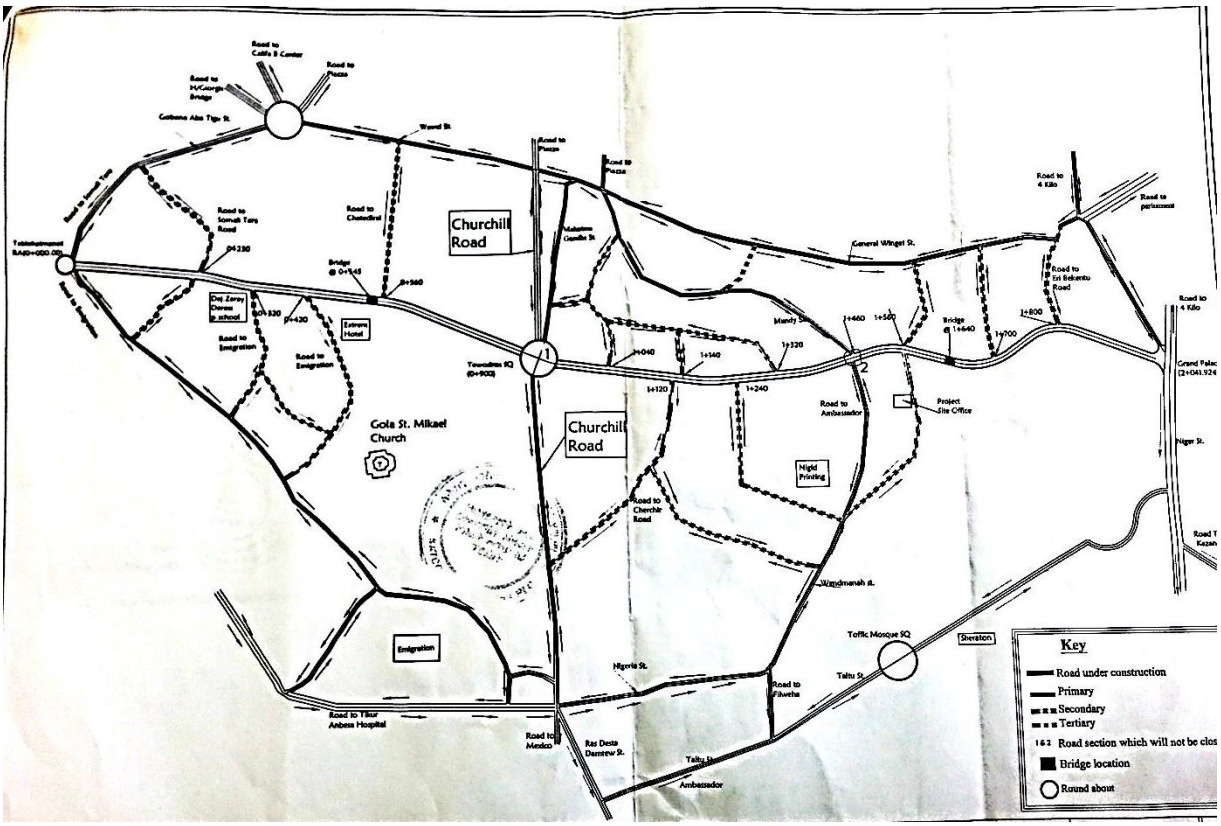
Annexes:

Annex A:

Interview Questions

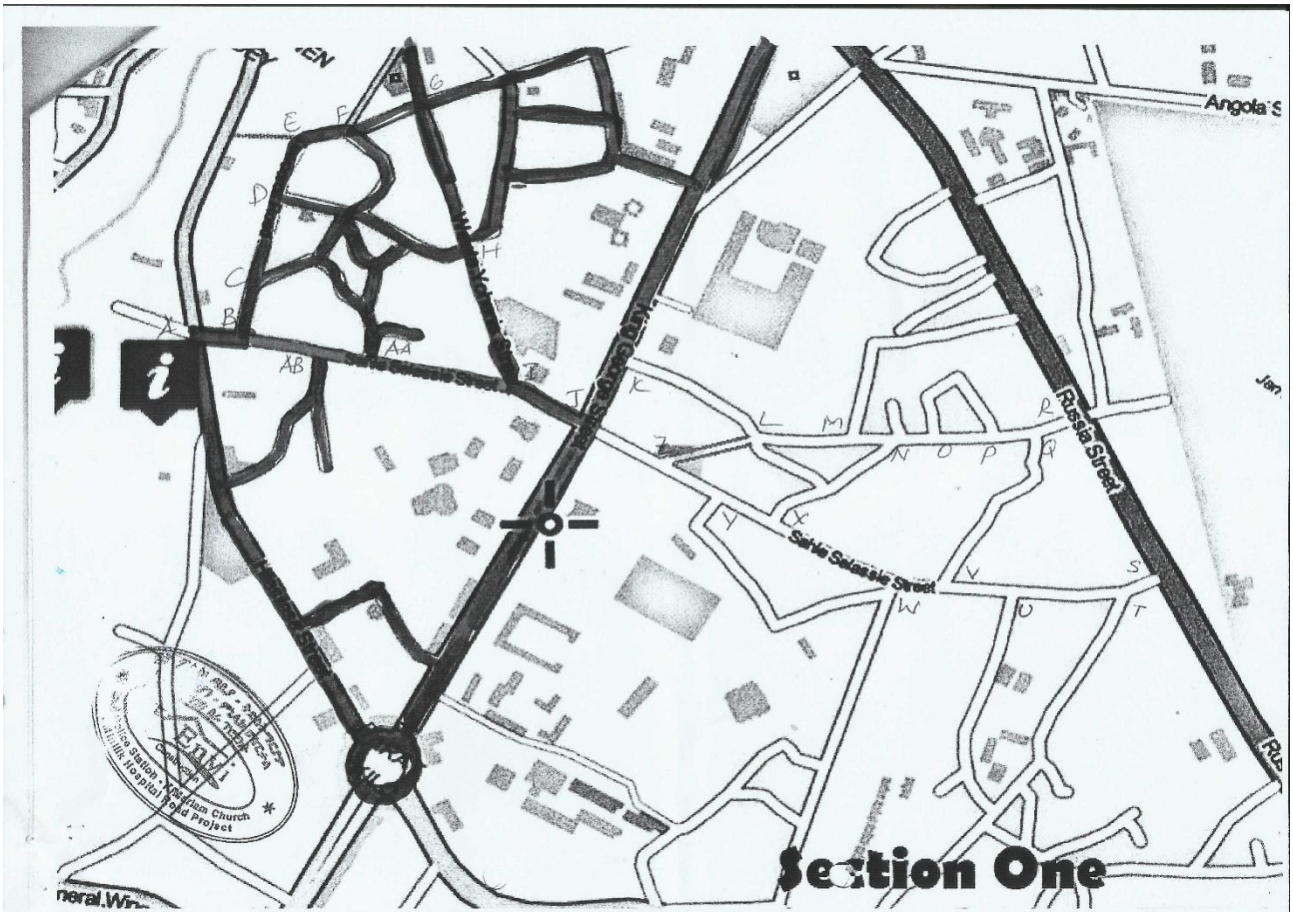
1. What is your position in the project?
2. Do you have traffic management plan?
3. Who prepared the traffic management plan?
4. Does it get approval from the client?
5. Did the approved traffic management plan communicated to mass media and traffic police?
6. Do you believe the approved TMP will solve the traffic problem at working?
7. Is it difficult to apply TMP?
8. Do you make regular supervision whether the approved TMP is implemented or not?
9. What do you do when there is a special occasion like holiday, church ceremony?
10. Have you received complaints from the public regarding access?
11. Did any accident happened on the site?

Annex B: T/Himanot – Nigid Printing Press – Grand Palace Road progect Traffic management plan

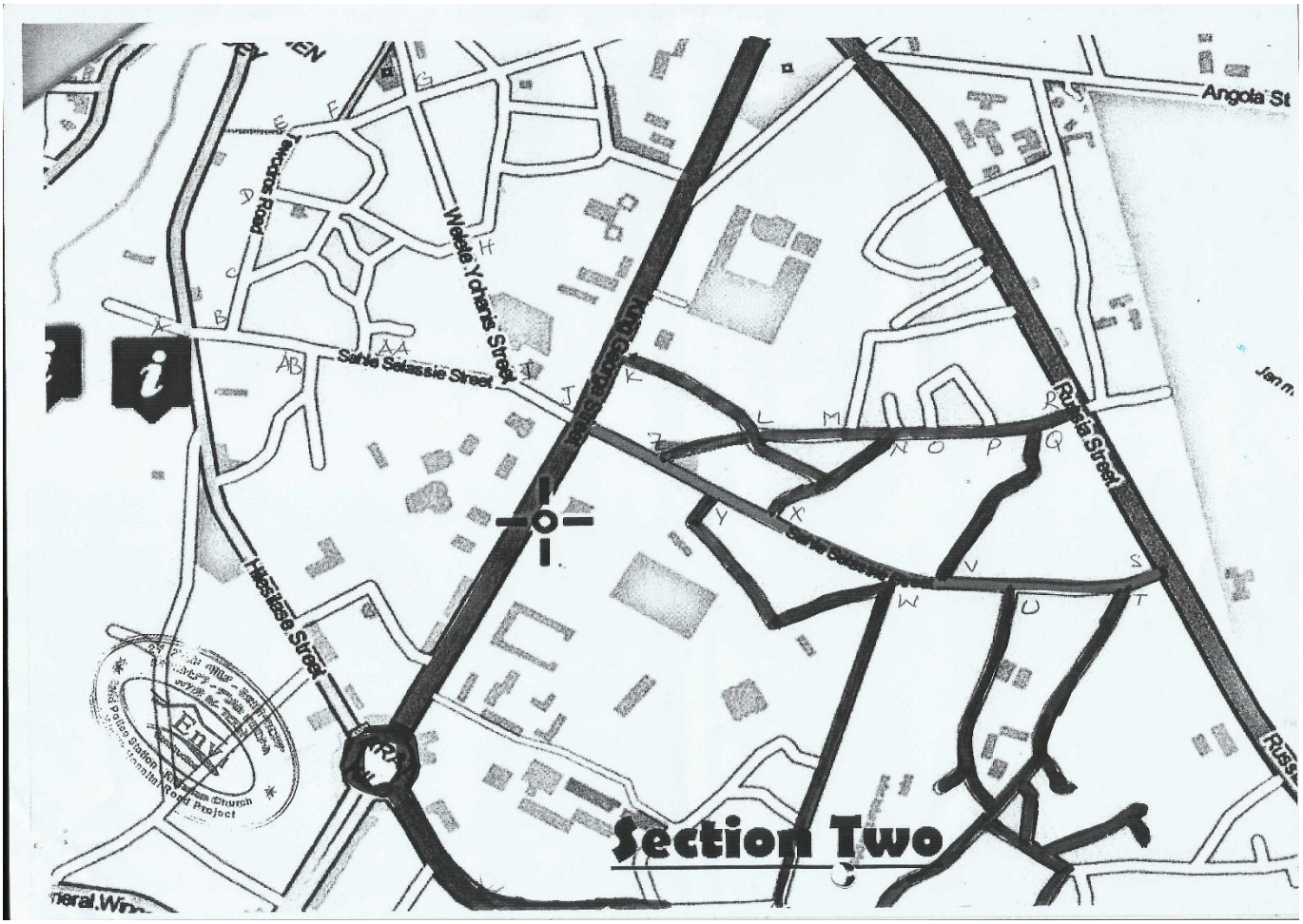


Annex C: 2nd police station – St.Mariam Church – Menilik Hospital Traffic Management Plan layout

Annex C1: section one



Annex C2: section Two, 2nd police station – St.Mariam Church – Menilik Hospital Traffic Management Plan layout



Annex D: 2nd police station – St.Mariam Church – Menilik Hospital Traffic management plan